ELECTRON BEAM DOMAIN PATTERNING IN THIN PLATES OF MAGNESIUM DOPED LITHIUM NIOBATE

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The electron beam domain patterning has been studied in the thin crystalline plates of MgO-doped lithium niobate covered by artificial dielectric layer. The creation of the through periodic domain structures with vertical domain walls and a period down to 2 μm was demonstrated in the thin plates.

We have studied the electron beam (e-beam) domain patterning in Z-cut optical grade plates of MgO-doped congruent lithium niobate (MgOLN) single crystals of two thicknesses: (1) 1-mm-thick, as purchased, and (2) 7-μm-thick produced by polishing. The irradiated Z- polar surface was covered by 2.5-μm-thick AZ nLOF 2020 photoresist layer. The 100-nm-thick solid copper electrode was deposited on the opposite surface and grounded during irradiation. The dual-beam Auriga Crossbeam Workstation (Carl Zeiss NTS) equipped with electron beam lithography system Elphy Multibeam (Raith GmbH) was used for e-beam irradiation [1]. The static domain structures at the surface were imaged non-destructively by piezoresponse force microscopy and scanning electron microscopy (SEM) in channeling-contrast backscattered electron mode after chemical remove of the resist layer and electrode. The confocal Raman microscopy (CRM) was used for domain imaging in the bulk.

The dot e-beam irradiation of LN crystals resulted in formation of the hexagonal isolated domains which is typical for switching in effective screening conditions [2]. We have found out the linear dose dependence of the switched area in both samples, while the domain area in the thin sample was about 2.5 times larger than in the thick one. The obtained behavior was attributed to external screening of the depolarization field by injected electrons, which are considered as an analog of the switching current in external circuit for traditional application of electric field by electrodes. Essential increase of the switched domain area for thin sample can be attributed to more effective external screening compared to the thick one. It was shown that the switched domain area is weakly dependent on the electron energy and the pattern period. The experimental facts were attributed to the equal values of screening charge at the same doses and various accelerating voltages and negligible electrostatic interaction between approaching neutral domain walls, respectively. The CRM domain imaging in the bulk showed that the domains with vertical walls grew through the thin sample which resulted in essential decrease of the domain wall interaction and uniform domain size distribution within the pattern.

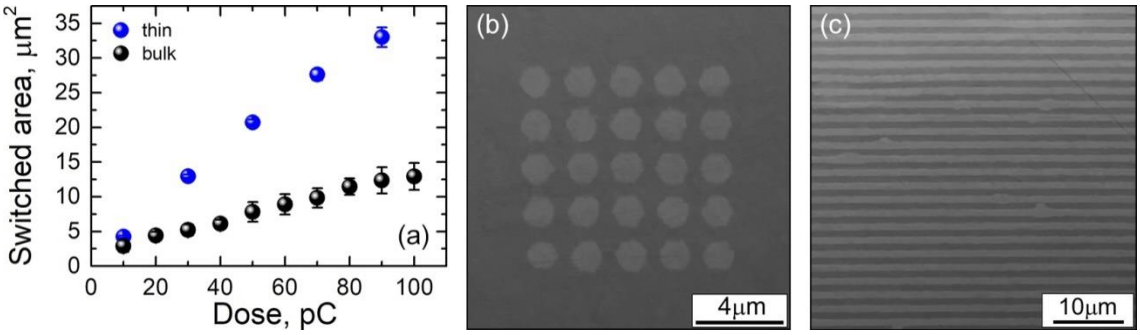

Fig. 1 (a) The dose dependence of the switched domain area for 7-μm-thick and 1-mm-thick plates. The channeling contrast SEM images of (b) 2D domain array and (c) 1D stripe domain grating with 2-μm-period.

The obtained study allowed revealing the optimal parameters for periodical poling with short periods, which have been used for creation of through 1D and 2D periodical domain structures with the neutral walls and period down to 2 μm.

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1. Vlasov E.O., Chezganov D.S., Pashnina E.A, et al., Ferroelectrics (in press).
2. Shur V.Ya., J. Mater. Sci., 41, 199 (2006).

ЗАВИСИМОСТЬ ОСНОВНЫХ ПАРАМЕТРОВ ПОВЕРХНОСТНОГО ПЛАЗМОНА НА ГРАНИЦЕ НАНОКОМПОЗИТА ОТ ОТНОСИТЕЛЬНОГО ОБЪЕМА НАНОЧАСТИЦ

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DEPENDENCE OF THE MAIN PARAMETERS OF THE SURFACE PLASMON ON THE BOUNDARY OF THE NANOCOMPOSITE ON THE RELATIVE VOLUME OF NANOPARTICLES

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Abstract. This paper presents the results of calculations of the dependence of the main parameters of the surface plasmon at the boundary of the nanocomposite — the longitudinal and surface frequencies — on the filling parameter

ПП образуют важное направление в исследовании наноматериалов и несут полезную информацию о свойствах их границы. Особый интерес представляют нанокомпозиты, в виде наночастиц в диэлектрической матрице.